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Review

General approach to hemoptysis

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ABSTRACT

Hemoptysis is bleeding from the mouth originating from the lungs or bronchi. It is one of the most important symptoms in chest diseases that leads to urgent admission and requires urgent intervention. Massive hemoptysis is defined as any life-threatening bleeding. Although an expected blood volume of more than 600 ml in 24 hours is often defined as massive hemoptysis, there is no universally accepted specific volume amount.The source of bleeding and its associated causes are frequently not readily identifiable, and the approach to managing this critical condition demands a swift intervention. In contrast to hemorrhage in various settings, even a minimal quantity of blood can quickly obstruct the airways, hindering both oxygen delivery and ventilation, which may result in asphyxiation and subsequent cardiovascular failure. Prioritizing the prompt management of the patient's airway and the immediate cessation of bleeding is crucial in efforts to identify and mitigate the hemorrhage. A well-coordinated team effort is vital to maximize the likelihood of patient survival.

Keywords: Hemoptysis, etiology, diagnosis, treatment

INTRODUCTION

Hemoptysis is the bleeding from the mouth originating from the pulmonary or bronchial vascular system. In other words, it is defined as the expulsion of blood through the mouth from a source located below the glottis level.[1,2] It is a symptom that generally causes panic in patients, causes them to seek medical attention immediately, and requires close monitoring.[3] Hemoptysis is held responsible for 6-8% of patients applying to chest diseases outpatient clinics and 11% of admissions to chest diseases services.[2] 50% of hemoptysis cases are mild, self-limiting, and have a good prognosis with conservative treatment. However, the mortality rate of massive hemoptysis cases is 50% .[2]

Hemoptysis is defined in terms of quantity as mild, moderate, severe and massive. Mild hemoptysis is defined as <100 ml in 24 hours, moderate hemoptysis as 100-600 ml in 24 hours, and massive hemoptysis as >600 ml/24 hours. The patient may swallow or aspirate some of the blood. Although it is generally defined as massive hemoptysis when the amount of blood expected in 24 hours is more than 600 ml, there is no specific amount that is universally accepted.[4,5] As a result, any hemoptysis that causes respiratory failure should be considered life-threatening hemoptysis.

In most patients, hemoptysis is minimal and resolves spontaneously. Massive hemoptysis is generally defined as the expectoration of a large amount of blood and/or rapid bleeding and is seen in rates ranging from 5% to 14% of patients.[4,6] The cause of death in massive hemoptysis is asphyxia rather than blood loss. Additionally, blood loss sufficient to cause cardiovascular collapse often results in death. Therefore, the mortality rate (50%) is generally higher in patients with massive hemoptysis that cannot be treated immediately.[7]

PATHOPHYSIOLOGY

Pulmonary vascular nutrition is provided by bronchial and pulmonary arteries. 99% of the blood going to the lungs is provided by the pulmonary arteries. The bronchial arterial system provides nutrition to the extra- and intrapulmonary airways and pulmonary vascular structures without providing gas exchange. It also helps feed the mediastinal lymph nodes, nerves, visceral pleura, esophagus and aorta through their vasovasorum. Pulmonary and bronchial arteries interact through microscopic anastomoses.[6] When the pulmonary circulation is under pressure due to reasons such as thromboembolic diseases, vasculitic disorders or

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hypoxic vasoconstriction, the blood flow provided by the surrounding anastomoses to the bronchial arteries increases. The wall of the bronchial arteries becomes hypertophic, increasing the possibility of bleeding into the bronchi and alveoli.[2,6]

While hemoptysis originating from the low-pressure pulmonary system causes low blood loss, bleeding from the high-pressure bronchial artery originating from the systemic artery is higher.[3]

While 90% of severe hemoptysis cases requiring treatment originate from the bronchial artery, 5% originate from the pulmonary artery. The remaining 5% consists of nonbronchial systemic arterial bleeding. Hemoptysis may also originate from nonbronchial systemic arteries due to revascularizations occurring in pleural adhesion areas and along the pulmonary ligaments caused by chronic inflammatory processes, and anastomoses with the pulmonary arterial circulation. It has also been shown that bleeding from the bronchial artery in a patient may be accompanied by bleeding from nonbronchial and pulmonary arteries. Hemoptysis, although rare, may originate from the pulmonary vein, bronchial vein and capillary (Figure 1).[2,3]

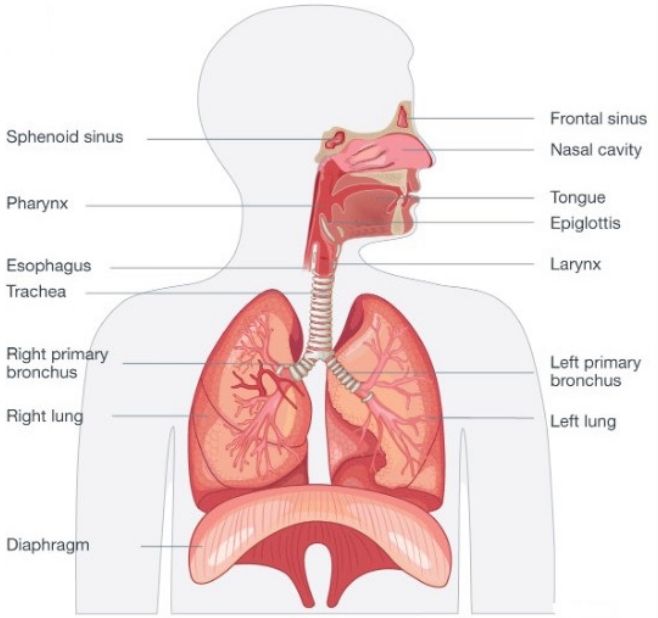

Figure 1. Human-respiratory-system

Information from https://openmd.com/guide/human-respiratory-system

ETIOLOGY

The causes of hemoptysis vary depending on patient characteristics, geographical region, time period, and diagnostic techniques.[2,6,7] Determination of etiology is important in hemoptysis. If hemoptysis is suspected, it should first be questioned whether the blood actually comes from the respiratory system. Anamnesis helps determine the anatomical location of bleeding and distinguish between hemoptysis and pseudohemoptysis. Nasopharyngeal or gastrointestinal causes must be excluded in patients presenting with hemoptysis. To ensure that bleeding is subglottic, the oral cavity and nasal cavity should be examined, taking into account that nasal or gingival bleeding overnight may result in hemoptysis the next morning (Table 1).[2,8]

The most common cause of hemoptysis worldwide is tuberculosis.[9-11] The most common cause of hemoptysis in patients between the ages of 40 and 60 is lung cancer, and it has been reported that the risk of malignancy is high in this age group, especially in smokers.[12,13] While in developed countries, acute bronchitis, bronchiectasis, fungal infections such as aspergiloma and cocaine-related pathologies are detected in patients with hemoptysis, pneumonia, bronchiectasis and tuberculosis are also observed in developing countries.[1,6,13] The causes of hemoptysis in our country are listed as bronchiectasis, bronchial carcinoma, tuberculosis and pneumonia.[14]

Other factors seen in hemoptysis are pulmonary embolism, aspergilloma staph aerus, pseudomonas aeriginosa, hydatid cyst, influenza, HIV, hypertension and CHF.[15]

Infections are the most common cause of hemoptysis, accounting for approximately 60-70%. Due to infection, inflammation and edema develop on the mucosal surface, causing superficial blood vessels to cracking.[2,3] Hemoptysis due to bronchiectasis usually requires hospitalization.[16]

Bronchogenic carcinomas constitute 5-44% of lung cancer responsible for hemoptysis. Hemoptysis may develop due to reasons such as superficial mucosal inflammation of cancer, cancer-related erosion in blood vessels, or vascular involvement. Infections secondary to obstructive lesion may also cause hemoptysis. Squamous cell lung carcinomas are associated with increased hemoptysis.[12,17]

Table 1 Differentiating hemoptysis from pseudohemoptysis[27,28]

	Hemoptysis	Pseudohemoptysis		
Etiology	Cardiorespiratory	Gastrointestinal	Upper respiratory (mouth, nose, throat)	Serratia marcescens
Associated symptoms and findings	Cough, dyspnea, chest pain Anemia is rare	Abdominal pain/tenderness, nau sea/ vomiting, black/tarry stools, history or signs of chronic hepatic disease, chronic nonsteroidal antiinflammatory drug use, heavy alcohol use, history of peptic ulcer disease, anemia frequently associated	Bleeding in oral cavity or nasal fossa (epistaxis, bleeding gums, gingivitis, telangiecta sias, ulcers, varices)	Recent hospitaliza tion, mechanical ventilation, pres ence of invasive device, recent procedure
Characteris tics of blood	Bright red, foamy Alkaline pH	Coffee ground (dark brown/black), mixed with food particles, present in nasogastric aspirate, acidic pH	Bright red Also present in upper respiratory tract	No red blood cells in sputum
Possible diagnostic tests	Chest radiography, computed tomography, computed tomography angiography, bronchoscopy	Esophagogastroduodenoscopy	Nasopharyngoscopy	Positive culture

Cardiovascular events resulting in pulmonary venous hypertension may cause cardiac hemoptysis. The most common cause is systolic cardiac failure due to left ventricular dysfunction. Additionally, severe mitral stenosis and pulmonary embolism are other causes.[13] Hemoptysis may be one of the first symptoms in diffuse alveolar hemorrhage.[18]

Pulmonary arterovenous malformations, peudoaneurysms and aortobronchial fistulas may result in hemoptysis.[6]

In the literature, the frequency of cryptogenic or idiopathic hemoptysis varies between 7-25%. The prognosis for idiopathic hemoptysis is generally good and after 6 months of follow-up, of disappears of these patients.[5]

Iatrogenic hemoptysis may occur due to endoscopic trauma during bronchoscopy, or in patients with thrombocytopenia, or due to the adverse effects of medications.[13]

Menstrual hemoptysis is menstruation-induced hemoptysis due to intrathoracic endometriosis. In these patients, the relationship of hemoptysis with the menstrual cycle and the ability to demonstrate radiological foci of hemoptysis during this period are important for diagnosis.[19] Although hemoptysis is rare in asthma patients, it can sometimes be seen during an attack in COPD patients.[20,21]

The optimal diagnostic approach for life-threatening hemoptysis has not yet been determined. Clinical algorithm (anamnesis, clinical and radiological findings and other further tests) leads to correct diagnosis (Table 2).

Table 2. Causes of hemoptysis[4,6]

System	Disease
Cardiovascular	Aortic aneurysm or bronchovascular fistula
	Arteriovenous malformation
	Congenital heart disease
	Congestive heart failure Mitral stenosis
	Pulmonary embolism/infarct
	Primary pulmonary hypertension
	Pulmonary artery aneurysm
	Ruptured thoracic aneurysm
Infectious	Bronchitis/pneumonia from bacterial and viral illnesses
	Lung abscess
	Mycetoma/invasive pulmonary fungal disease (aspergillosis)
	Necrotizing pneumonia
	Parasites
	Septic embolism
	Tuberculosis/nontuberculous mycobacteria
Neoplastic	Bronchiectasis
	Broncholithiasis
	Cystic fibrosis
	Lymphangioleiomyomatosis
Autoimmune	Anti-glomerular basement membrane disease
	Anti-phospholipid syndrome
	Bechet's disease
	Cryoglobulinemia
	Diffuse alveolar hemorrhage from vasculitis
	Goodpasture syndrome
	Granulomatous with polyangiitis
	Henoch-Schonlein purpura
	Microscopic polyangiitis
	Mixed connective tissue disease
	Rheumatoid arthritis
	Systemic lupus erythematosus
	Systemic sclerosis
Hematologic	Disseminated intravascular coagulation
	Latrogenic coagulopathies (anticoagulants/antiplatelet medications)
	Platelet disease
	Thrombotic thrombocytopenic purpura
Other	Cryptogenic
	Drugs: anticoagulants/antiplatelet, bevacizumab, crack/cocaine, nitrofurantoin
	Foreign body aspiration latrogenic
	Trauma

DIAGNOSIS

Factors such as the presence of symptoms suggestive of infection, recent surgical procedures, administration of anticoagulant or antiplatelet drugs, or a known history of tuberculosis, malignancy, autoimmune condition or chronic lung disease, recent travel, parasitic, inactivity, family history of coagulation disorders, may determine the etiology.[22] Patients with hemoptysis should be monitored for tachycardia, tachypnea, weight loss and hypoxia. Color changes such as cyanosis, telangiectasias, pallor, ecchymosis on the skin and mucosal membranes may be indicators of bleeding. Lymph node examination in the neck, axilla and scalene area is important in terms of malignant diseases. The presence of jugular venous distention, edema, additional sounds and murmurs may be cardiovascularly significant. The presence of a previous history of hemoptysis is important for diagnosis. Hemoptysis that recurs several times a year is important in smokers with chronic bronchitis, COPD, and lung cancer. Environmental factors such as asbestos, arsenic, chromium, nickel, and similar substances are other factors that increase the risk of haemoptysis.[23]

Physical examination is nonspecific in hemoptysis. The history and physical examination should focus on determining the etiology of bleeding. Complete blood count is useful in identifying thrombocytopenia contributing to hemoptysis. Coagulation panel, blood group determination and cross-matching should be performed.[6]

Standard PA chest radiography, thorax computed tomography (thorax CT) and fiberoptic bronchoscopy (FOB) are the most commonly used diagnostic methods. Chest radiography is the first examination method that can be performed quickly, cheaply and easily in patients with hemoptysis. Identifying and localizing the bleeding focus with chest radiography is important in diagnosis. It indicates underlying parenchymal or pleural infection, chronic lung diseases, atelectasis, alveolar hemorrhage, cavitary lesions at the bleeding site. In cases with negative chest radiography, thorax CT and/or bronchoscopy should be evaluated.[8,24,25]

Thorax CT is recommended before bronchoscopic evaluation in patients with hemoptysis.[2] Thorax CT is a noninvasive test that provides information about the lung parenchyma, airways and thoracic vessels in patients with hemoptysis using contrast material. Accuracy varies from 63% to 100% and can indicate underlying causes such as lung cancer, bronchiectasis, respiratory infection.[26]

In angiographic evaluation on thorax CT, the pulmonary arterial system as well as bronchial and non-bronchial arteries should be imaged to identify the bleeding focus, reduce recurrences, and indicate embolizations and endobronchial treatments. With thorax CT, new vascular formations originating from normal or hypertrophic bronchial arteries, aortic branches and intercostal arteries in the mediastinum can be clearly seen.[24,25] Multidetector tomographies can show bronchial and non-bronchial systemic arterial bleeding foci more clearly.[23]

Tomography is better than bronchoscopy in detecting the underlying cause. While the rate of detecting the underlying cause with bronchoscopy is 8%, this rate is around 77% with thorax CT. Despite this, bronchoscopy is an indispensable diagnostic method in endobronchial lesions localized in the distal bronchial structures.[5]

Bronchoscopy is accepted as the primary method, especially in the diagnosis and localization of massive hemoptysis. Bronchoscopy is most useful in detecting endobronchial lesions in diagnosis and treatment.[6] It also evaluates the bronchial mucosa, allows taking samples for tissue pathology and microbial tests, and removing blood and foreign bodies.[27] Fiberoptic bronchoscopy is preferred in patients requiring airway control and in patients with bilateral lung disease.[3] While rigid bronchoscopy is used effectively to control endobronchial bleeding, the possibility of providing bleeding control with the more frequently used FOB is more limited. Rigid bronchoscopy is performed under general anesthesia. It also allows for the removal of blood or foreign objects and shrinkage of the tumor. However, the rigid bronchoscope only reaches the proximal airways unless an additional device is attached. In intensive care, flexible bronchoscopy can be performed at the bedside with sedation instead of anesthesia. If intervention in the respiratory tract is required, intubation should be performed beforehand.[13,28] The best result is the combined use of BT and FOB.[23]

Digital angiography (DSA) is a diagnostic and therapeutic procedure that can provide endovascular treatment in patients with a bleeding focus previously detected by examinations such as CT angiography.[29]

Those with massive hemoptysis, hemodynamic instability, or respiratory distress should be treated in an intensive care unit with access to radiological, endovascular, bronchoscopic, and surgical care.[2,13]

TREATMENT

Hemoptysis has three purposes; It is important to prevent aspiration, stop bleeding, and determine the underlying cause.[23] Patients with respiratory distress should be intubated and remnants of the endobronchial clot should be aspirated immediately. During active bleeding, the lateral decubitus position should be taken on the side where the bleeding occurs, strict bed rest should be ensured, and oral intake should be stopped.[3,26] Patients should be provided with oxygen support and bronchoscopy should be performed within 48 hours at the latest. Bronchoscopy allows identification of the bleeding site, washing the bleeding site with ice or adrenaline serum, buffering the bleeding focus with a balloon, and coagulation with electrocautery, laser and argon plasma in malignant cases.[2,4]

Borderline data are available for antifibrinolytics such as tranexamic acid. However, it can be used to prolong bleeding volume and duration.[4,13]

Endovascular embolization therapies are currently an effective and less invasive method.[30] Endovascular embolization reduces the pressure within fragile hypertrophic vessels, also regulating the preoperative condition.[23] Despite the frequent recurrence rate, BAE is the primary treatment. Bronchial artery embolization, commonly performed as it is often responsible for massive hemoptysis, is an endovascular embolization method that achieves 90% bleeding control.[4-6] Additionally, embolization of non-bronchial systemic arteries or pulmonary arteries should be considered.[4,6] Arterial embolization is the preferred treatment for massive or recurrent hemoptysis and is increasingly being used for non-massive hemoptysis due to its minimally invasive nature.[3,31] The technical success rate of embolization ranges from 81% to 100%. However, the likelihood of failure is higher in the presence of extrabronchial systemic collaterals and bronchopulmonary shunts. If there is no pathology in the bronchial circulation, non-bronchial systemic and pulmonary vessels can be considered.[4]

If the cause of hemoptysis is thoracic trauma or iatrogenic pulmonary vascular trauma, surgical treatment is the primary option.[6,31] Surgical intervention is the definitive treatment in cases of hemoptysis resistant to other options, where the source of bleeding is unilateral and well localized, lung reserve is sufficient, or after the patient is stabilized.[28] Surgical procedures may include pneumonectomy, lobectomy, segmentectomy, wedge resection, thoracoplasty, cavernostomy, bronchial artery ligation, and devascularization. Surgery has a high mortality risk (2-18%), and due to the high risk of complications such as perioperative bleeding, asphyxia, bronchopleural fistula, respiratory failure, this rate can increase up to 25-50% in active bleeding and emergency situations (Figure 2, 3).[28]

CONCLUSION

Haemoptysis is a significant pulmonary symptom that can arise from various aetiologies. More than half of the cases presenting with complaints of haemoptysis at secondary healthcare facilities are comprised of infectious causes and idiopathic haemoptysis. The advancement of preventive medicine today, along with progress in diagnosis and treatment, leads to changes in the frequency of diseases in haemoptysis aetiology and highlights haemoptysis associated with more prominent diseases. Patients with haemoptysis should be evaluated together by pulmonology, thoracic surgery, and interventional radiology based on the severity.

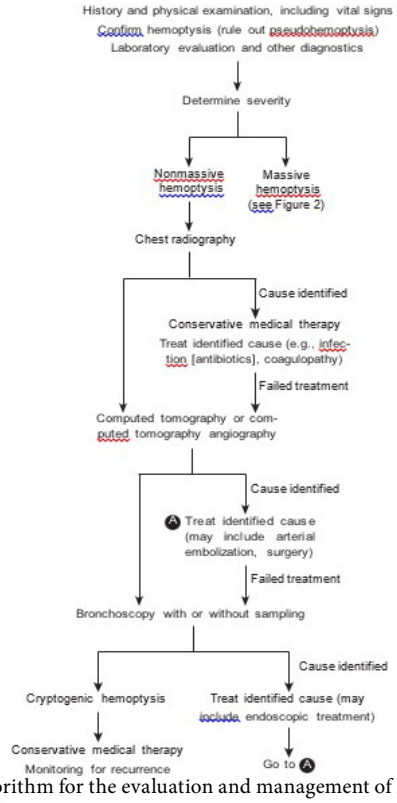

Figure 2. Algorithm for the evaluation and management of nonmassive hemoptysis[22,31]

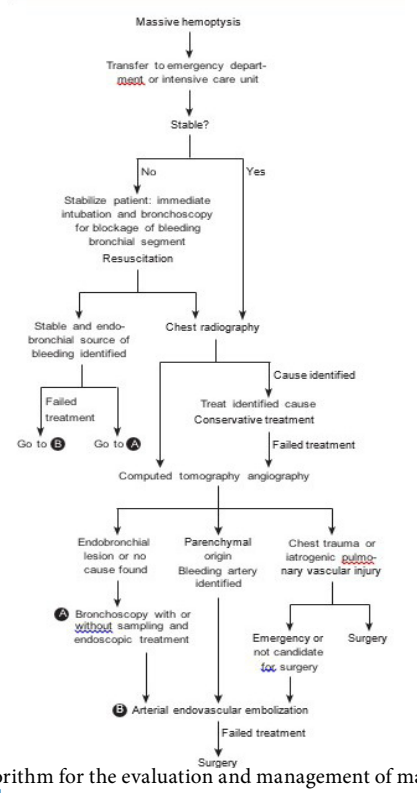

Figure 3. Algorithm for the evaluation and management of massive hemoptysis[22,31]

ETHICAL DECLARATIONS

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclwosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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